HIO AGRICULTURAL EXPERIMENT STATION

SMALL FRUIT CULTURE

Wesley P. Judkins

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Small Fruit Culture

WESLEY P. JUDKINS

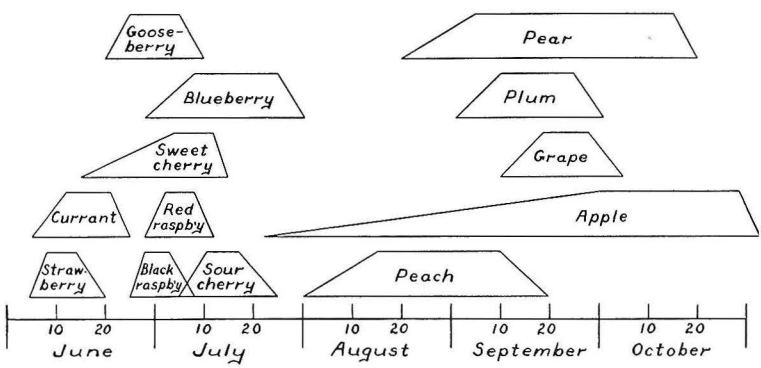
Many different kinds of berries such as strawberries, red and black raspberries, blackberries, grapes, currants, gooseberries, and blueberries can be grown successfuly in Ohio either by the commercial grower or the backyard gardener. Small fruits are probably better adapted for home production than are most tree fruits because they require less space and do not need as much spraying to control insects and diseases.

For the commercial grower, a properly managed berry planting can give a high profit per acre and is a good enterprise for diversifying the farm program.

Small fruits are not difficult to grow but the greatest success is obtained when adequate attention is given to site and soil, variety selection, and to the various cultural operations. This circular is intended to supply the commercial grower or backyard gardener with condensed information on berry culture. More detailed information on particular berries or cultural operations may be obtained by consulting the technical publications of the Experiment Station.

Varieties

The best small fruit varieties are those which are productive, dependable, of high quality, and relatively resistant to insects and diseases. If the commercial planting is to be profitable, the importance of selecting good varieties cannot be over-emphasized.

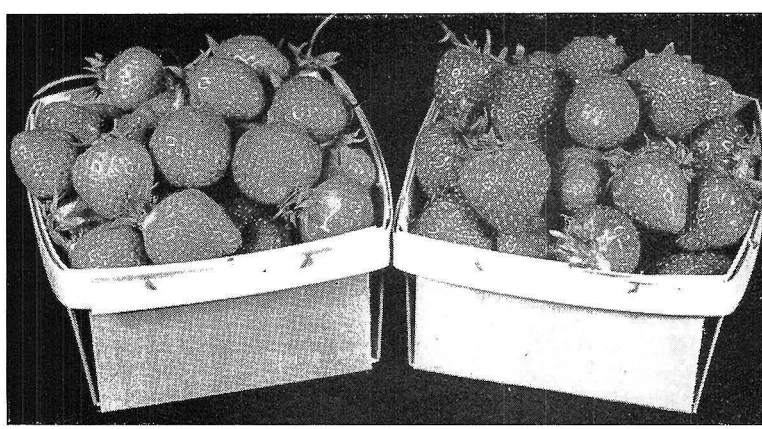


Ripening season for different fruits at Wooster, Ohio

The selection of dependable varieties by the home gardener is as important as for the commercial grower. The site and soil of the backyard may not be well adapted to berry growing and equipment for insect and disease control may be lacking. In some cases, the hobby gardener may wish to sacrifice yield and dependability and produce special varieties which are of high quality, but, as a rule, this is a hazardous procedure.

The information illustrated at the bottom of page 3 is of assistance in selecting varieties which will ripen at different seasons and thus utilize the labor supply to better advantage. Careful selection of varieties will help the commercial grower maintain a continuous supply of fruit on a roadside or local market, and will provide the home gardener with fresh fruit from early June until November.

Results of fruit variety tests are published from time to time in Farm and Home Research, the bimonthly bulletin of the Ohio Agricultural Experiment Station. An evaluation of strawberry varieties (Judkins[1]) may be of interest to some readers.



Premier (left) the most dependable strawberry for Ohio. Midland (right) a promising new variety.

Strawberries.—Premier (early) is the most productive and dependable variety of strawberry for Ohio at the present time. Midland (early midseason) is a promising new variety with an attractive round-conic berry which is somewhat darker colored and of better quality than Premier. Catskill (midseason) is a large high quality variety which has been very satisfactory in some areas

[1]Judkins, Wesley P. 1944. Strawberry variety performance in Ohio. Ohio Agr. Exp. Sta. Bimo. Bull. **29**: 266-267.

but is not as dependable as Premier. Fairfax (midseason) is less productive than the above named varieties but is very high in quality.

Sparkle is a promising late midseason variety, is high in quality, a fine berry for freezing, and is at least partially resistant to the red stele root rot disease. Chesapeake and Redstar are the best late-ripening strawberries but are much less productive than the early ripening varieties.

Gem is probably the best everbearing variety at the present time. Gemzata is also quite good. Most everbearers produce much smaller crops of berries during the early part of the season than do the regular June-bearing varieties. If satisfactory midsummer and fall crops are to be harvested, a system of mulching or irrigation should be followed as discussed in the cultural section of this circular. Green Mountain is a good everbearing variety which produces a large crop of berries in June but may be less productive than Gem during the latter part of the season.

Black raspberries.—Logan and Bristol are early ripening varieties which seem superior in yield and quality to Cumberland, a standard variety in commercial plantings for a number of years. Logan is now being successfully planted by commercial growers. In a somewhat limited number of trials, Bristol seems superior to Logan and may eventually replace this latter variety.

Morrison and Naples ripen a little later than the above named varieties and may have limited value to extend the picking season. These late ripening black raspberries are less productive than the earlier types.

Red raspberries.—Latham (midseason) continues to be the best red raspberry for planting in Ohio. It should be selected as the principal variety in all commercial or home plantings.

Taylor (midseason) is somewhat higher in quality and less susceptible to crumbling than Latham. In most tests Taylor has not proved to be as productive and hardy as Latham. Sunrise (early), Milton (late), and Indian Summer (everbearer) may be useful for extending the harvesting period.

Purple raspberries.—Sodus and Marion are the preferred varieties of purple raspberries. They have replaced Columbian because of greater resistance to mosaic.

Blackberries.—Eldorado (early midseason) is the best blackberry for Ohio. Alfred (early) and Ward (late) may also be planted to extend the picking season.

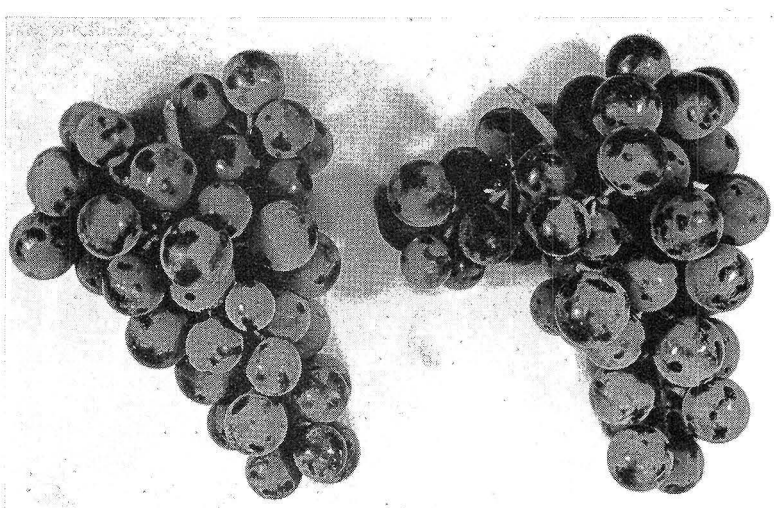
Grapes.—Concord (blue, midseason) is without question the most important grape in Ohio. The fruit of Concord is suitable for use as a dessert grape, as well as for jelly, jam, juice, or wine. Fredonia is a desirable blue grape which ripens about 10 days before Concord. Sheridan is a fine blue grape which ripens about a week after Concord. Due to its late ripening season, Sheridan will not ripen properly in most sections of Ohio.

Niagara is the standard white grape which ripens in midseason with Concord. White grapes have a more limited usefulness than blue grapes since they are not usually considered desirable for juice, jelly, or jam. Niagara is less hardy than Concord and more susceptible to fungus diseases.

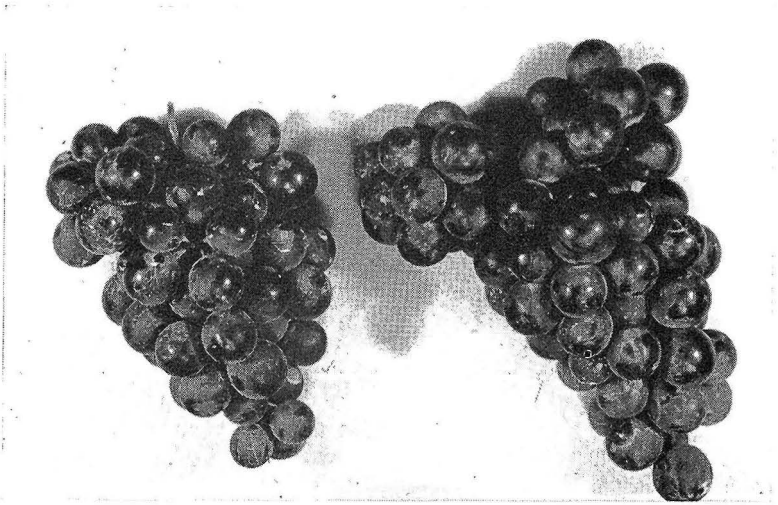
Delaware is a standard, red, midseason variety which has very high dessert quality. Delaware is suitable for juice and is highly prized for making fine wine and champagne. The vines of Delaware are slow-growing and because of the small size of the clusters, the yield per vine or per acre is not equal to other standard varieties.

Catawba is a red grape which requires a long growing season and is produced in the Sandusky area and on the islands of Lake Erie just north of Sandusky.

Van Buren is a promising early blue grape. Dunkirk is a new midseason red variety which is recommended for trial.



Concord, the standard blue grape for Ohio.



Dunkirk, a promising new red grape.

Currants.—Wilder (midseason) and Red Lake (late) are the preferred types of currants for Ohio.

Gooseberries.—Poorman is the best red fruited gooseberry for Ohio. If a green fruited variety is desired, Downing should be planted.

Blueberries.—Jersey (late) is probably the best general purpose blueberry. Rancocas (early), Stanley (midseason), Atlantic (late), and Burlington (very late) may be planted in limited numbers to extend the harvesting period.

Bush cherries.—The Nanking cherries as well as the Korean and Hanson hybrid types have aroused considerable interest, especially among backyard gardeners. The plants are shrub-like in growth, and quite hardy. The fruit of most varieties is small and tart, and the seeds may be rather large in proportion to the size of the fruit.

Although the fruit of the bush cherry may be used for culinary purposes, the principal value of these plants seems to be as an ornamental shrub. The flowers and fruit are very attractive in early summer, while the leaves turn an attractive red in autumn.

Boysenberries are not a satisfactory crop for Ohio. The canes are susceptible to killing by cold winter weather and this reduces the fruiting area for the following season. The trailing, thorny canes need to be trained along a trellis or fence and this is a laborious procedure, at best.

Although the fruits are large and attractive, they are sour and poor in quality unless thoroughly ripened before being picked. Furthermore, the final ripening process proceeds rapidly and the berries become soft in a very short time unless they are picked immediately. Ants and bees feed readily on the ripe berries.

Lastly, the plants are very susceptible to crown gall. This disease may entirely destroy a planting in 1 or 2 year's time.

All factors considered, the berry grower will derive much more satisfaction, fruit, and profit from raspberries or blackberries than from boysenberries.

Loganberries, dewberries, and youngberries have many of the weaknesses of boysenberries and are not adapted to Ohio conditions.

Pollination

Pollination refers to the transfer of pollen from the anthers to the stigma of the flower. The flowers of fruit plants must be pollinated if the small ovulary, which is a part of the flower, is to grow into an edible product. Insects, especially bees, must be present if the pollination of fruit plants is to take place.

Blackberries, *raspberries*, *currants*, and *gooseberries* are for the most part self-fruitful.

The important *grape* varieties are self-fruitful. Many of the old varieties have been discarded because of sterile pollen or reflexed stamens which are ineffective in pollination. The grower should consider this matter of pollination before planting old or unknown varieties of grapes.

The important *strawberry* varieties have perfect flowers which need no provision for cross-pollination. Some of the older varieties such as Sample and Howard Supreme have imperfect flowers devoid of stamens and, therefore, require an interplanting of perfect-flowered varieties if fruit is to be produced.

Most *blueberry* varieties appear to produce satisfactory crops of fruit when planted alone and without provision for cross-pollination. Some workers have reported that yields have been increased when several varieties are interplanted. Since most growers will desire more than one variety to provide an extended picking season, it may be advisable to plant several varieties together to insure pollination. Two rows of one kind followed by two of another is the usual recommendation.

Bush cherries are largely self-sterile and at least two varieties should be planted to provide for cross-pollination.

Climate, Site, and Soil

With the exception of *boysenberries*, *dewberries*, and other trailing brambles, the varieties of small fruits described in this circular are quite hardy and well adapted to the climatic conditions of Ohio.

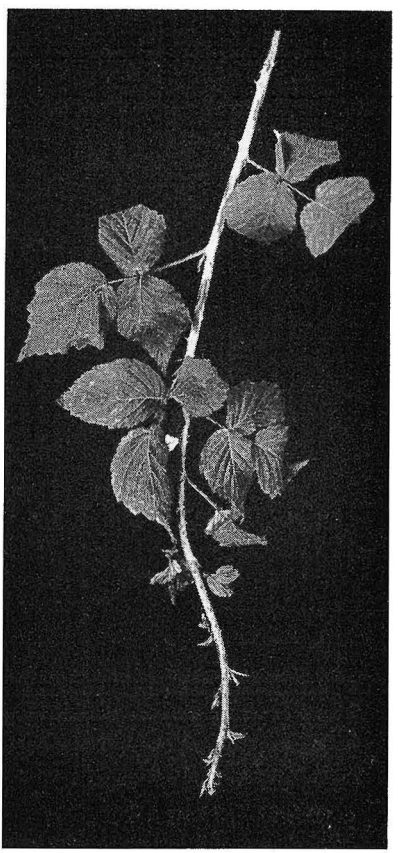
Small fruits should be planted on elevated, sloping land that is free from frost pockets. A deep well-drained fertile soil is best for most berries.

Blueberries prefer an acid soil (pH 4.0 to 5.0) containing a liberal supply of organic matter and with a water table 14 to 22 inches below the surface. Some growers have had success in adding sulfur or other acidifying materials to a soil to make it suitable for blueberries but such a practice is expensive and may give only mediocre results.

Propagation and Selection of Plants

As a rule, the home gardener and most commercial growers should purchase well-grown, healthy, 1-year-old plants from a nursery rather than attempt to produce their own. However, some growers find the production of plants a profitable sideline. If care is taken to keep diseases and insects under control, good plants can be produced satisfactorily if the berry patch is located on a good soil.

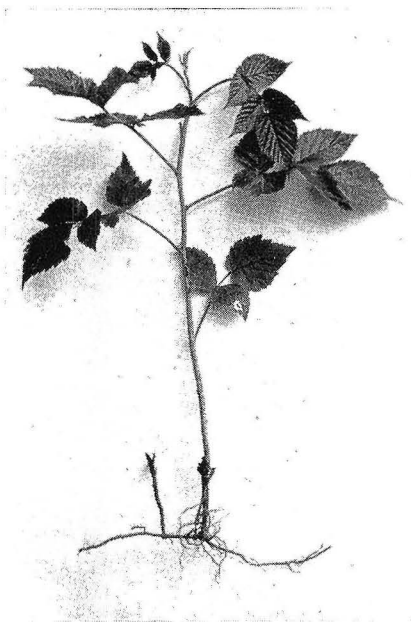
Strawberries are propagated from runner plants formed during the summer. Only vigorous, well-rooted, 1-year-old runner plants should be used in setting a new patch, not the 2-year-old original plants of the old planting.



Black raspberry cane with elongated tip ready for layering.

The *black*, and most of the *purple raspberries*, are propagated by tip-layering. When the tips become elongated and light in color, in late August, they are inserted vertically into the soil to a depth

of 3 to 4 inches. The easiest method is to thrust a small pointed shovel into the ground, move back and forth to make a V-shaped opening, insert the elongated end of the cane and firm the soil around it by tramping with the foot. The following spring the rooted tips are ready for transplanting.



Red raspberry plant ready for transplanting.

Red raspberries are propagated by suckers or shoots which arise from underground stems around the parent plant. In late fall or early spring these young plants can easily be transplanted. It is preferable to move as many roots as possible and keep the plants moist at all times. Plants of *purple raspberries* and *blackberries* may also be secured in this way.

When *blackberry* plants are desired in large numbers they are propagated by root cuttings. For best results, the roots should be about one-fourth inch in diameter. The roots are dug in the fall, cut in pieces about 3 or 4 inches long and buried outdoors in moist sand in a well-drained location. In spring, the cuttings are planted 3 to 6 inches apart in furrows 2 or 3 inches deep. The cuttings may be taken in the spring and planted immediately, but autumn is the preferred season for this operation.

Grapes and *currants* are propagated from cuttings of dormant canes of the previous year's growth. Cuttings should be about 8 to 10 inches long and taken during the winter from canes which are about one-fourth inch in diameter. These sticks are then tied in bundles of any convenient number and buried top-end down in moist moss in a cool storage. The cuttings should contain at least three nodes so that two can be in the soil and one above ground when the cuttings are planted in the nursery row. In spring, the cuttings are planted firmly in the soil 6 to 8 inches apart, in rows 3 feet apart. *Grapes* may also be propagated by layering if only a few plants are needed.

Gooseberries are ordinarily propagated by mound layering. This procedure consists of cutting back all branches in early spring to leave stubs from 3 to 4 inches long. In July, the vigorous shoots which develop are mounded up about half their length with earth. The rooted shoots thus secured may be removed and transplanted in the fall or spring. Gooseberry plants may be secured by layering if only a limited number are desired.

Blueberries are usually propagated from cuttings taken in late April and rooted in ground peat moss. Special care is needed to insure success and the person desiring to produce blueberry plants should study detailed directions which can be secured from the Experiment Station.

It is usually better for both the commercial and home gardener to purchase 2- or 3-year-old blueberry plants than to attempt to produce his own.

Planning and Planting

Before berries are planted, the grower should consider carefully the location and arrangement of the planting. If properly planned, the berry enterprise should fit in with other farm activities and provide a profitable diversification which does not seriously compete with other jobs for labor or equipment.

In the backyard, the small fruit area should be located at one side of the lot so as not to interfere with the annual spring plowing of the vegetable garden.

Planting season.—Berry plants should be set out just as early in the spring as the ground can be prepared. With the exception of *strawberries*, fall planting (late September or early October) may be satisfactory unless followed by a very cold winter.

Fall planting of *strawberries* is not recommended for they usually produce only a 15 to 25 percent crop the following June because no runner plants have been established. Since the plants should be protected with mulch during the winter to prevent injury by cold and heaving, the fall-planted bed must be mulched for two winters before a full crop of fruit can be expected.

In the home garden, fair success may be obtained by transplanting strawberry plants from a bearing bed at the end of the picking season in late June or early July. If rainfall is adequate or irrigation can be practiced, a good stand of runner plants may be obtained and, therefore, a good crop of fruit the following June.

Planting distance and yield data.—The planting distances given in table 1 indicate minimum distances which are applicable to the home garden, and maximum spacing which is necessary in the commercial planting where tractors and standard farm implements are used in cultural operations.

TABLE 1.—Planting distance, yield, duration of planting, and plants needed per acre for berries in Ohio

	Planting distance		Plants per acre*	Yield per plant	Yield per acre	Life of plants
	Between rows	In the row				
	Feet	*Feet*		*Quarts*	*Quarts*	*Years*
Strawberry	3½- 4½	1½	6,450-8,300	¼- ¾	2,000-5,000	2- 3
Black raspberry	6 - 9	2	2,400-3,650	¾- 1	1,500-3,000	8-10
Red raspberry	6 - 9	2½	1,950-2,900	½- 1	1,000-2,000	8-10
Blackberry	7 -10	3	1,450-2,100	1 - 1½	2,000-4,000	10-12
Currant	6 - 8	5	1,100-1,450	3 - 6	3,000-5,000	12-15
Gooseberry	6 - 8	5	1,100-1,450	3 - 6	3,000-5,000	12-15
Blueberry	6 -10	5	850-1,450	2 - 4	1,500-3,000	30-50
Grape	6 -10	7-9	500-1,000	6 -12	2,000-4,000	25-30

*The number of plants required to plant an acre may be determined accurately by multiplying the distance in feet between rows by the distance between plants in the row and dividing the result into 43,560, the number of square feet in an acre.

The yield data of table 1 are intended to indicate average production on good soils when approved cultural practices are followed. Under poor conditions, yields may be considerably lower and in favorable seasons the production may be appreciably higher.

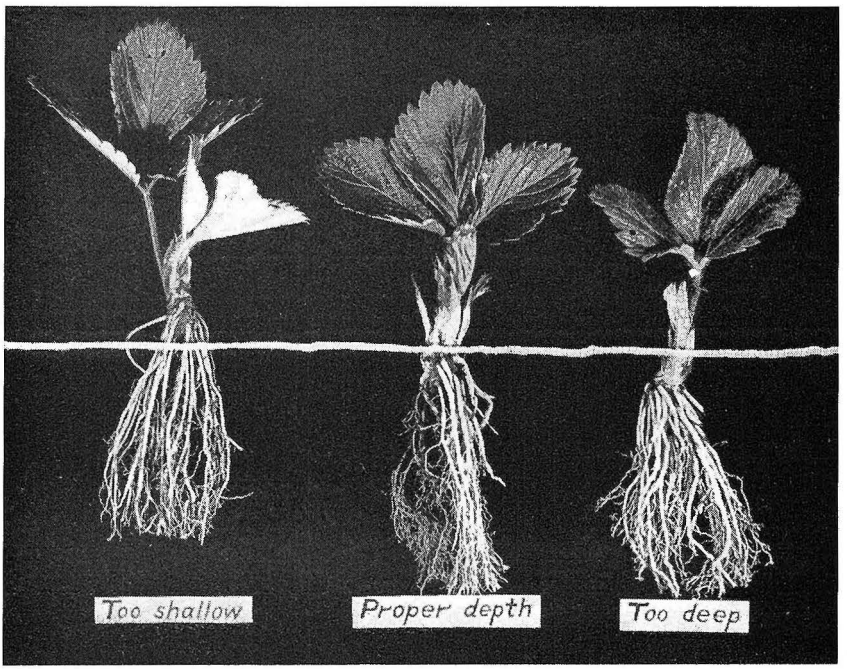
Duration of planting.—The average productive life of various berries is indicated in table 1. Attacks of diseases or insects or unfavorable growing conditions may make a berry planting worthless at a younger age than is indicated in this table.

Setting the plants.—Small fruit plants should be set in a well-prepared soil, preferably one which was occupied by a vegetable garden or other cultivated crop the previous year. Weed control is easier in such a soil and damage by white grubs is usually much less than in berries which are planted on land that was in sod the previous year.

In loose soils a sufficiently large hole may be made for small-rooted plants by inserting a shovel deeply into the earth and moving it back and forth to make a V-shaped opening. In heavier soils or with large plants, a hole should be dug to receive the roots. In all cases the roots should be carefully spread out to insure a quick resumption of growth.

Best results will be obtained if plants are set out as soon as they are received from the nursery. If the soil is dry, it is advisable to apply water around the roots at the time of planting.

Strawberries should be set firmly in such a way that all the roots are below the ground and yet no soil is present over the crown of the plant. This can be easily seen in the following illustration.



Strawberry plants illustrating proper and improper planting depths.

Raspberries, blackberries, grapes, and *blueberries* should be set slightly lower than they were in the nursery. *Currants* and *gooseberries* should be set with the base of the lower branches just below the surface of the soil to encourage the development of a bush rather than a tree type plant. Broken and diseased roots should be removed and long rangy branches should be cut back.

In *black* and *purple raspberries* which are propagated by tip-layering, the "handle" or short section of the parent cane should be removed at planting time because it is frequently a source of anthracnose infection.

Precaution.—Black raspberries should be located at least 300 feet from red raspberries to reduce the spread of virus diseases from the red to the black varieties. Strawberries should not be set in soils where previous plantings have been injured by red stele disease.

Cultural Practices

Berries require careful cultivation or the use of a liberal amount of mulch to control weeds which compete with the plants for nutrients and moisture. If the planting is to be cultivated and the site is on sloping land, the rows should run along the contours of the slope to prevent erosion. Information on the cost of producing strawberries has been published (Judkins[2]) and is available for any reader who desires such material.

Strawberries require cultivation throughout the growing season. Weeds and grass must be controlled if large crops of easily harvested berries are to be produced. In late November or early December a 3-inch mulch of straw, about 3 tons per acre, should be applied over the entire plantation. The best time to apply the mulch is after the plants have been hardened-off by a few sharp freezes and when the ground is frozen to a depth of 1 or 2 inches. The mulch should be applied before the real cold winter weather occurs because unprotected strawberry plants may be injured if the temperature drops below 20° Fahrenheit.

The mulch is removed from the plants in mid-April when growth starts and the green leaves under the mulch start to turn yellow. The mulch should be left between the rows to suppress weeds, conserve moisture, and prevent the berries from becoming dirty from contact with the soil.

Sawdust (either fresh or weathered) has been used as a mulching material for strawberries by a number of growers, usually around everbearing varieties. One common procedure is to keep the new planting well cultivated and free from weeds until the runners start to develop freely. At this time about 1 inch of sawdust is applied uniformly over the entire planting. The young runners are then set by hand on each side of the parent plants forming a triple row with the individual plants spaced 10 to 12 inches apart in all directions. (Illustrated on page 16). During the remainder of the season the weeds are controlled by pulling and hand hoeing, and all additional runners are pulled off.

In most instances sawdust would not be as economical and satisfactory as straw when used as a mulch for June bearing varieties. A cubic yard of sawdust should be sufficient to mulch 250 to 325 square feet of area.

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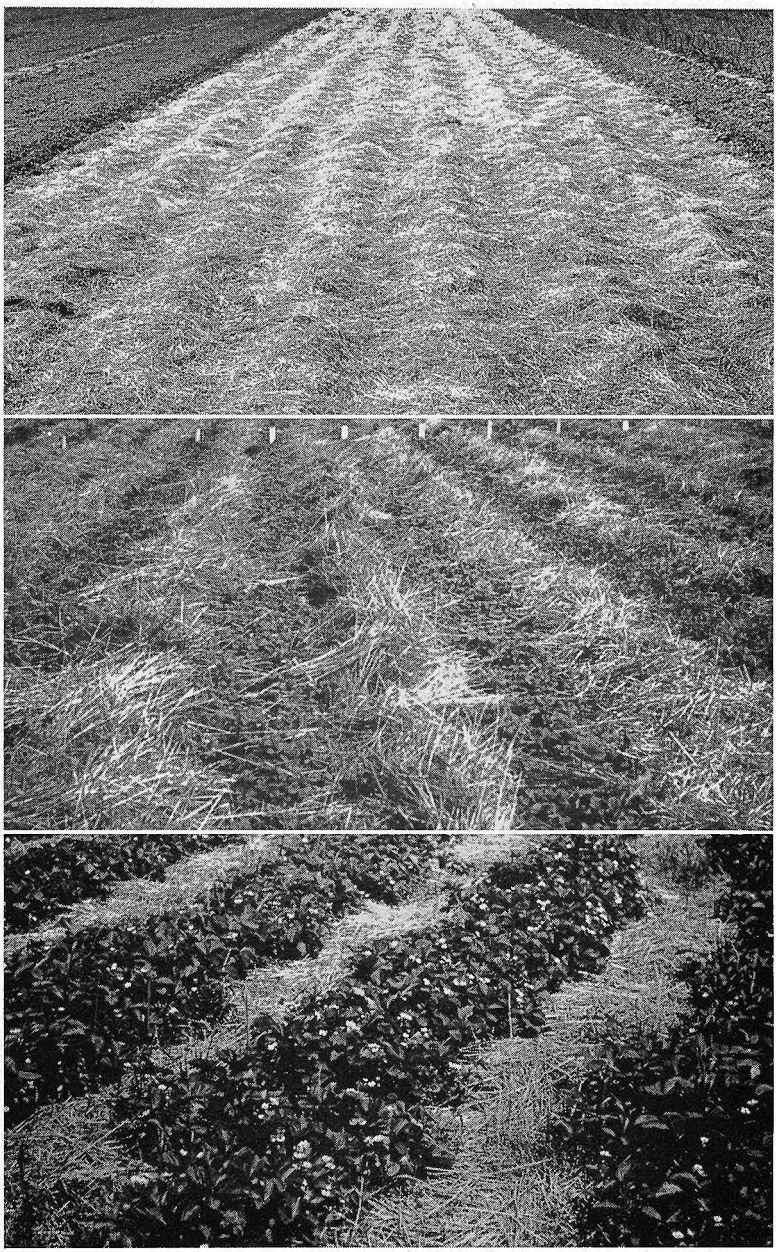
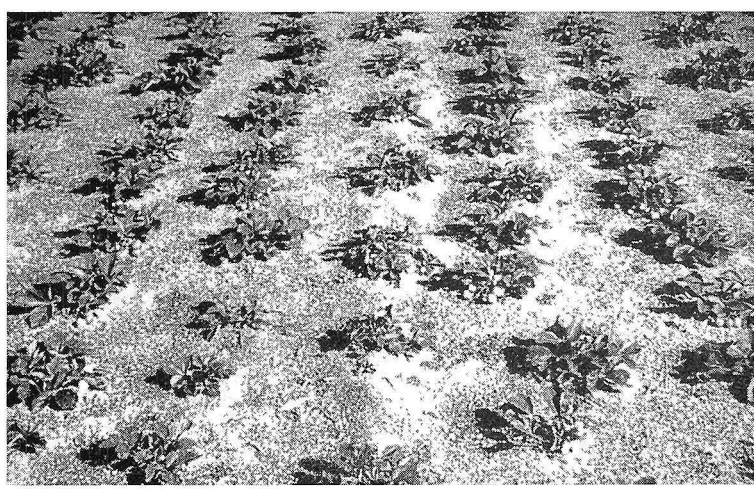
[2]Judkins, Wesley P. 1943. Cultural methods influence strawberry production costs. Ohio Agr. Exp. Sta. Bimo. Bull. 30: 124-126.



A strawberry bed mulched with straw in preparation for winter (top). In the spring, the straw is removed from the plants (center) and left between the rows and around plants to suppress weeds and conserve moisture. Properly mulched berries (bottom) should result in a high yield of clean fruit.

Raspberries, blackberries, grapes, currants, gooseberries, and *blueberries* are usually cultivated during the early part of the growing season. A summer cover crop of soybeans may be planted in early July. In September or early October a winter cover crop of wheat or rye should be planted. These cover crops help maintain organic matter in the soil and prevent erosion.

The use of mulch, such as straw, old hay, sawdust, or other organic material, is an excellent practice (Judkins[3] [4]) for most bush type berry plants. Such a mulch prevents erosion, conserves moisture, eliminates the need for cultivation, and promotes good growth and yields. The principal difficulty may be in securing an adequate supply of mulching material at a reasonable price. About 8 tons of straw are required per acre for the original application, followed by 3 tons each succeeding fall to maintain the mulch at a sufficient depth to suppress the growth of grass and weeds.



Gem everbearing strawberries under sawdust mulch system of management.

Mice may damage berry bushes where a mulch is used unless the material is kept about a foot from the plant stems and poison is

[3]Judkins, Wesley P. 1944. The effect of straw mulch, cultivation and nitrogen fertilizer on the growth and yield of Latham raspberries. Ohio Agr. Exp. Sta. Bimo. Bull. **29**: 154-158.

[4]Judkins, Wesley P. 1945. The effect of cultivation, straw mulch, and sod plus mulch on the growth and yield of black raspberries. Ohio Agr. Exp. Sta. Bimo. Bull. **30**: 166-172.

distributed to reduce the mouse population. Certain types of insects may cause an increased amount of damage when mulch is used unless special attention is given to the spray program.

Black raspberries under straw-mulch system of management.

A mulch of sawdust or peat moss is especially beneficial around blueberry plants.

Renovating Strawberry Plantings

Most commercial growers in Ohio pick only one crop of strawberries and then destroy the planting. The difficulty of controlling weeds in a 2-year-old strawberry bed, plus the smaller size of the berries and reduced yields which are usually secured in a second-year crop of fruit, seem to justify such a procedure.

In some cases, however, where the strawberries are located on good soil and are free from weeds and damage by insects or disease, it may be desirable to hold the bed over for a second crop.

Experiments conducted in Ohio and other states indicate that drastic renewal treatments, such as have been recommended in the past, are unnecessary in a healthy strawberry planting. In fact, such practices may reduce rather than increase yields of the second crop. The best treatment seems to be to keep weeds under control and possibly dig out a few of the older crowded plants with a hand hoe.

Blossom Removal from Strawberries

Most strawberry plants have young flower buds in the crown at the time they are set out in the spring. These buds develop into flowers, and, if allowed to ripen a crop of fruit, may prevent the

young plant from making optimum growth and thus may limit the number of runner plants which are established. A good stand of runner plants is essential if large yields of berries are to be secured.

As a rule, it is advisable to remove the blossoms from strawberry plants during their first season of growth. This removal is especially important if the plants lack vigor or if the soil is infertile or lacking in moisture. The removal of strawberry flowers is a laborious task on a large acreage but should probably be done at least 4 or 5 times during the first month or 6 weeks after the plants are set in the field.

In the case of everbearing strawberries, the flowers should be removed until the first of August after which time the plants may be allowed to produce fruit.

Irrigation

Rainfall in Ohio is frequently inadequate during some part of the growing season to promote optimum growth and fruitfulness of berry plantings. For this reason the grower should consider seriously the possibility of irrigation, especially if his soil is sandy or shallow and is thus of a "drouthy" nature.

An experiment at Wooster, in which strawberry plants were irrigated six times during their first season of growth when runner plants were being formed, produced 89 percent more berries the following June than non-irrigated plants on the same soil. On a per acre basis, the irrigated plants produced 5,560 quarts as compared to 2,940 for the non-irrigated plants. This increase in yield was equal to a gain of $786.00 per acre if the strawberries were sold at 30 cents per quart. The improvement in yield in this case was due to an increased number of runner plants. Commercial growers and home gardeners should consider seriously the possibilities of using irrigation as a means of increasing strawberry yields.

Fertilization

Soil analysis may be useful in showing pronounced deficiencies of nutrient elements in the soil but their value in this connection is often greatly exaggerated. After the soil analysis has been made the estimation of the amounts and kinds of fertilizer to be used should be decided by a county agent or other person who is qualified to make such decisions because of their education and experience. In most sections of Ohio, fruit plants respond to applications of nitrogen but may not be benefited by other elements which are usually present in sufficient quantities in the soil.

Soil acidity is one of the most important items reported in a soil analysis. Berry plants are tolerant of a wide range of acidity but it is nevertheless important that the pH value of the soil be maintained within the optimum range indicated by the following figures.

	Optimum pH range
Strawberry, black raspberry, gooseberry	5.0 — 6.5
Red raspberry, currant, grape	5.5 — 7.0
Blueberry	4.0 — 5.0

Cover crops usually grow best in soils with a pH of 6.0 to 6.5. Therefore, it is desirable to add lime to bring the soil to this approximate value (except for blueberries) even though the berry plants may not be directly benefited by such a practice. On sandy soils, about 1 ton of ground limestone is needed per acre to raise the soil 1.0 pH in value, about 2 tons is needed on silt-loam soils, and about 2.5 tons on clay-loam soils. On a small backyard garden this amounts to about 5 pounds per 100 square feet on sandy soils, 10 pounds on silt-loam soils and 12 pounds on clay-loam soils.

Raspberries, blackberries, currants, gooseberries, and *grapes* will give increased yields on most soils if 6 to 8 tons per acre of cow or horse manure is applied. Poultry manure may be used at the rate of 2 or 3 tons per acre. If manure is not available an application of 300 pounds per acre of a 20 percent nitrogen fertilizer or its equivalent may be used. The fertilizer or manure should be applied in early spring just before growth starts.

In small plantings use about 4 pounds of nitrate of soda or ammonium sulfate per 100 foot of row, or 3 pounds of ammonium nitrate. Cow or horse manure may be used at the rate of about 250 pounds per 100-foot row, or poultry manure at 100 pounds for the same area.

If a mulch of straw or other organic material is used around the berry plants, it is especially important that a nitrogen fertilizer be applied during the first few years when the mulch system is being established. Such a practice prevents the development of a deficiency of soil nitrogen which may occur when the soil bacteria tie up the available nitrogen during the process of decomposing liberal amounts of organic matter.

Strawberries produce the largest yields on fertile soils which have received an application of 8 or 10 tons of manure per acre at the time the land is prepared for planting. The use of commercial fertilizers on strawberries has given inconsistent results. This

inconsistency is indicated by the fact that in some cases experimental plots and growers plantings have been benefited by an application of 75 or 100 pounds per acre of a 20 percent nitrogen fertilizer or its equivalent during the first growing season. In other cases no increases in yield are secured by such a practice.

The grower should conduct tests on a few rows at the edge of his planting to determine how well the plants will respond to fertilizer treatment on his particular soil. Some tests indicate that the best results may be secured by applying the fertilizer in late May or early June, about a month or 6 weeks after the plants are set in the field. Other trials indicate that early August is the best time, when the runner plants are taking root in appreciable numbers. As has been stated previously, the results secured from the use of commercial fertilizers on strawberries are not uniform. On fertile soils there may be no improvement in growth or yield following such practices.

As a rule, nitrogen fertilizer should not be used around strawberries in the spring of the fruiting year as it may delay ripening and cause soft berries.

There is some indication that the use of 200 to 400 pounds of superphosphate per acre, applied on top of the mulch in February, may improve yields of strawberries.

Blueberries should be fertilized with a 7-7-7 or 6-10-6 fertilizer applied at the rate of 1 ounce per year of plant age until a total of 8 ounces per plant is being used. The potassium of the fertilizer should be in the form of sulfate of potash because injury may result if muriate of potash is used.

Blueberries require an acid soil. If the site has a pH value higher than pH 5.0, it may be desirable to increase the acidity by applying sulfur. On sandy soils use ¾ pound sulfur per 100 square feet for each 1.0 pH over pH 4.5. For example, a sandy soil with pH 6.5 would require 1½ pounds of sulfur per 100 square feet. A silt loam soil would require about 1½ or 2 pounds of sulfur per 100 square feet for each 1.0 pH over 4.5. Heavier soils require even more but blueberries should not be planted on heavy clay soils.

Pruning and Training

The pruning of small fruits is not difficult but it is one of the most necessary operations. The purpose of pruning is to make it possible for the plant to produce a maximum yield of high quality fruit over a long period. Development of plant strength is an important consideration.

Strawberries are not pruned as are the bush and vine type berry plants. Larger fruit, and sometimes higher yields, may be obtained if the runner plants are spaced about 6 inches apart in the hedgerow. This practice may be accomplished while the plants are being weeded and hand hoed. As a rule, commercial growers do not feel that there is a sufficient improvement in the crop to justify the extra work.

Black and purple raspberries and *blackberries* are summer-pinched to encourage the development of lateral fruiting branches. This operation consists of removing 3 or 4 inches of the top of the canes in the early part of the growing season. Black raspberries should be tipped to a height of about 20 inches, and purple raspberries and blackberries to a height of about 30 inches.

Black raspberry bush after the dormant pruning operation is completed.

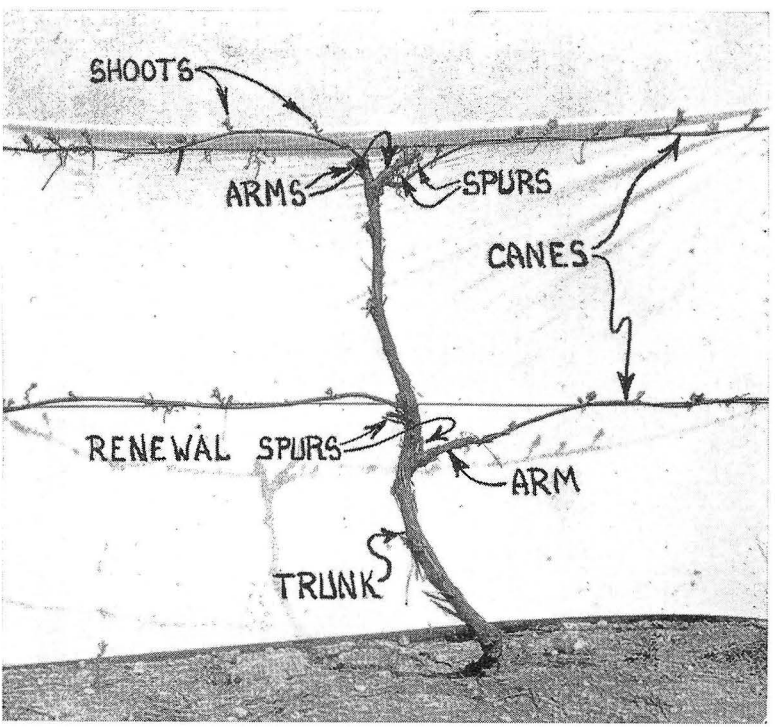
The dormant-season pruning of black raspberries consists of cutting back the lateral branches to a length of about 8 inches. Lateral branches of purple raspberries and blackberries should be cut back to a length of 12 to 14 inches. This dormant-season pruning should be performed in late winter or early spring after the coldest weather is past.

Red raspberries are not tipped in the summer and require very little pruning, except the removal of the old canes. If the canes grow too tall it may be desirable to remove a small amount of the top in the early spring. Most of the fruit of the red raspberries is produced on the upper part of the cane and, therefore, severe pruning will reduce the yield.

Raspberry and *blackberry* canes produce only one crop and then die. These old canes may be removed as soon as the crop is harvested or during the late winter or early spring when the dormant-season pruning is done.

In all brambles, the weak, small canes should be removed at the time of the dormant pruning. The hedgerow should be maintained at a width of not more than 15 inches at the ground.

Grapes are usually trained to a 2-wire trellis, although 3 wires are used in some vineyards. When the plant is set out, all the weak canes should be removed and the most vigorous cane cut back to a stub having 2 buds. At the beginning of the second season, the strongest cane should be selected and stretched up vertically and tied firmly to the trellis. All other canes should be removed.



Four-cane Kniffin system of pruning grapes.

At the beginning of the third season, four lateral branches are selected and trained along the trellis in the form of a horizontal "H." Each lateral arm should be reduced to a length of 6 to 10 buds, depending on the vigor of the vine.

Grapes produce fruit on shoots which grew the previous season, and, therefore, the future training of the vine consists of a constant renewal of these 4 lateral branches. With a vigorous vine, 40 or 50 buds may be left distributed about equally over the 4 canes. If more fruiting wood is left the yield may be slightly larger but the berries will be smaller and of poorer quality.

Currants and *gooseberries* produce the most fruit on spurs located on 2- and 3-year-old wood. It is essential that mature bushes be pruned each year during the dormant season, leaving about 8 canes per plant, including about equal numbers of 1-, 2-, and 3-year-old wood. All canes over 3 years old should be removed.

In the drooping type bushes, the low branches near the ground should be removed, leaving the more erect growing stems. In erect growing types an effort should be made to thin out the canes to give a more spreading bush. No heading-back of canes is necessary in most currant and gooseberry varieties.

Training *blueberries* is mainly for the purpose of producing a vigorous erect-spreading type of bush which will produce large crops of good sized berries. During the first 2 or 3 years, the plants require little or no pruning. The pruning of mature blueberries consists of the removal or cutting back of the older canes and removal of the weak shoots less than 6 inches long in the center of the plant.

Diseases and Insects

Most backyard plantings of small fruits will produce fairly good crops of berries with little or no attention to insect and disease control.

Commercial berry growers should spray raspberries and blackberries to control anthracnose, and should watch for the appearance of any insect or disease which might reduce the crop or destroy the planting. If problems do arise, the grower should consult the spray program and pest control bulletin which is obtainable by writing to the Ohio Agricultural Experiment Station, Wooster, Ohio.

Healthy, disease- and insect-free plants should be purchased from reliable nurseries. The berry planting should be rotated to new ground when a new planting is started to reduce the development of soil-borne diseases such as root rots and crown gall. This practice also reduces the hazard of insect injury, especially with strawberries.

Harvesting

Berries should be picked in as ripe a condition as is consistent with the type of handling and shipping they are to receive before reaching the consumer. Commercial growers who sell on a local market or roadside stand should allow the fruit to reach nearly full maturity so the customer will receive a high quality product. Home gardeners likewise should allow the fruit to become fully mature before it is picked.

The determination of optimum maturity is largely a matter of experience on the part of the grower. As the fruit ripens it acquires its characteristic color and is more easily removed from the plant. Taste as well as the degree of softness attained by the fruit are also factors which are useful in determining the proper time to pick.

Fruit which is to be shipped to a distant market should be picked in a firm-ripe or slightly immature condition. The actual degree of ripeness depends on the distance and method of shipment. Only experience can determine the time to pick fruit in such circumstances.

Berries should, if possible, be picked in early morning after the dew has dried off and placed immediately in a cool place out of the sun.

Pickers should be given special instructions to handle the berries carefully at all times. Rough handling causes bruising which seriously reduces the keeping quality of the fruit.

If the berries are to be sold as a fancy product, they should be graded to remove the poorer specimens. In most cases, this can be done most efficiently by the pickers as the fruit is harvested in the field.

Packages for berries should be attractive, sufficiently strong to protect the fruit, economical in price and of a convenient size and shape. A cellophane cover over the individual baskets of berries protects the contents and makes the package more attractive.